<u>What is Claimed is:</u>

1   1. A fine granularity scalable encoder comprising:

2   a base-layer encoding block including a coarse prediction loop, said coarse prediction

3   loop having a coarse prediction output;

4   an enhancement-layer encoding block including a fine prediction loop and an

5   enhancement-layer mode selector, said fine prediction loop having a fine prediction

6   output;

7   wherein said encoder operates in a mix prediction mode when said enhancement-

8   layer mode selector is switched to select said fine prediction output, and said encoder

9   operates in an all-coarse prediction mode when said enhancement-layer mode selector

10   is switched to select said coarse prediction output.

1   2. The fine granularity scalable encoder as claimed in claim 1, said base-layer encoding

2   block further comprising a base-layer mode selector, wherein said encoder operates in

3   an all-fine prediction mode when both said base-layer mode selector and said

4   enhancement-layer mode selector are switched to select said fine prediction output,

5   said encoder operates in an all-coarse prediction mode when both said base-layer

6   mode selector and said enhancement-layer mode selector are switched to select said

7   coarse prediction output, and said encoder operates in a mix prediction mode when

8   said base-layer mode selector is switched to select said coarse prediction output and

9   said enhancement-layer mode selector is switched to select said fine prediction output.

1   3. The fine granularity scalable encoder as claimed in claim 2, further comprising a

2   mode decision unit for adaptively controlling said enhancement-layer and base-layer

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3   mode selectors.

1   4. The fine granularity scalable encoder as claimed in claim 3, said mode decision unit

2   further comprising a mismatch estimation unit for estimating mismatch errors

3   between said said coarse prediction output and said fine prediction output.

1   5. The fine granularity scalable encoder as claimed in claim 4, further comprising a

2   worst-case base-layer decoder for providing a worst-case coarse prediction output to

3   said mismatch estimation unit.

1   6. A fine granularity scalable decoder comprising:

2   a base-layer decoding block including a coarse prediction loop, said coarse prediction

3   loop having a coarse prediction output;

4   an enhancement-layer decoding block including a fine prediction loop and an

5   enhancement-layer mode selector, said fine prediction loop having a fine prediction

6   output;

7   wherein said decoder operates in a mix prediction mode when said enhancement-

8   layer mode selector is switched to select said fine prediction output, and said decoder

9   operates in an all-coarse prediction mode when said enhancement-layer mode selector

10   is switched to select said coarse prediction output.

1   7. The fine granularity scalable decoder as claimed in claim 6, said base-layer decoding

2   block further comprising a base-layer mode selector, wherein said decoder operates in

3   an all-fine prediction mode when both said base-layer mode selector and said

4   enhancement-layer mode selector are switched to select said fine prediction output,

5   said decoder operates in an all-coarse prediction mode when both said base-layer

6   mode selector and said enhancement-layer mode selector are switched to select said

7   coarse prediction output, and said decoder operates in a mix prediction mode when

8   said base-layer mode selector is switched to select said coarse prediction output and

9   said enhancement-layer mode selector is switched to select said fine prediction output.

1   8. An encoding method having at least two coding modes, said method comprising the

2   steps of:

3   (a) collecting encoding parameters from each macroblock of a plurality of

4   macroblocks of input signals;

5   (b) analyzing said encoding parameters to determine a coding mode for each

6   macroblock; and

7   (c) encoding each macroblock according to the coding mode determined in said step

8   (b).

1   9. The encoding method as claimed in claim 8, wherein said plurality of macroblocks

2   are classified in said step (b) into at least two coding groups and each macroblock in a

3   coding group is assigned with a same coding mode.

1   10. The encoding method as claimed in claim 8, wherein said encoding method has an

2   all-coarse prediction mode, an all-fine prediction mode, and a mix prediction mode,

3   and said plurality of macroblocks are classified in said step (b) into an all-coarse

4   prediction group in which each macroblock is assigned with said all-coarse prediction

5   mode, an all-fine prediction group in which each macroblock is assigned with said

6   all-fine prediction mode and a mix prediction group in which each macroblock is

7   assigned with said mix prediction mode.

1   11. The encoding method as claimed in claim 8, wherein said encoding method includes a

2   base layer with coarse prediction and an enhancement layer with fine prediction, and

3   encoding parameters collected from each macroblock in said step (a) include a fine

4   prediction error value, a coarse prediction error value, and best-case and worst-case

5   mismatch errors in fine prediction.

1   12. The encoding method as claimed in claim 11, wherein said encoding method has an

2   all-coarse prediction mode, an all-fine prediction mode, and a mix prediction mode,

3   and said plurality of macroblocks are classified in said step (b) into an all-coarse

4   prediction group in which each macroblock is assigned with said all-coarse prediction

5   mode, an all-fine prediction group in which each macroblock is assigned with said

6   all-fine prediction mode and a mix prediction group in which each macroblock is

7   assigned with said mix prediction mode.

1   13. The encoding method as claimed in claim 11, wherein said plurality of macroblocks

2   are classified into at least two coding groups according to a coding gain derived from

3   said fine and coarse prediction error values of each macroblock and a predicted

4   mismatch error derived from said best-case and worst-case mismatch errors of each

5   macroblock.

1   14. The encoding method as claimed in claim 13, wherein said encoding method has an

2   all-coarse prediction mode, an all-fine prediction mode, and a mix prediction mode,

3   and said plurality of macroblocks are classified in said step (b) into an all-coarse

4   prediction group in which each macroblock is assigned with said all-coarse prediction

5   mode, an all-fine prediction group in which each macroblock is assigned with said

6   all-fine prediction mode and a mix prediction group in which each macroblock is

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7   assigned with said mix prediction mode.

1   15. The encoding method as claimed in claim 14, wherein the coding gain of a given

2   macroblock divided by the predicted mismatch error of the given macroblock is

3   defined as the coding efficiency of the given macroblock, and the given macroblock

4   is then assigned with one of said all-coarse prediction mode, said all-fine prediction

5   mode and said mix prediction mode according to the coding efficiency of the given

6   macroblock.

1   16. The encoding method as claimed in claim 15, wherein a coding efficiency mean and

2   a coding efficiency standard deviation are computed from the coding efficiencies of

3   said plurality of macroblocks, and the given macroblock is assigned with one of said

4   all-coarse prediction mode, said all-fine prediction mode and said mix prediction

5   mode by comparing the coding efficiency of the given macroblock to values

6   determined by said coding efficiency mean and said coding efficiency standard

7   deviation.

1   17. The encoding method as claimed in claim 16, wherein the given macroblock is

2   assigned with said all-coarse prediction mode if the coding efficiency of the given

3   macroblock is smaller than the difference of said coding efficiency mean and a pre-

4   determined multiple of said coding efficiency standard deviation, the given

5   macroblock is assigned with said all-fine prediction mode if the coding efficiency of

6   the given macroblock is larger than the sum of said coding efficiency mean and a pre-

7   determined multiple of said coding efficiency standard deviation, and otherwise the

8   given macroblock is assigned with said mix prediction mode.

1   18. A method for truncating bit-planes in an enhancement layer of a group of pictures for

2 allocating bits sent to a client channel, comprising the steps of:

3 (a) performing low-rate bit truncation if total bits available for allocation for said

4 enhancement layer are less than or equal to total number of enhancement-layer

5 bits in all I/P-frames in said group of pictures used for fine prediction;

6 (b) performing medium-rate bit truncation if total bits available for allocation for said

7 enhancement layer are less than or equal to total number of enhancement-layer

8 bits in said group of pictures used for fine prediction but greater than total number

9 of enhancement-layer bits in all I/P-frames in said group of pictures used for fine

10 prediction; and

11 (c) performing high-rate bit truncation if total bits available for allocation for said

12 enhancement layer are greater than total number of enhancement-layer bits in said

13 group of pictures used for fine prediction.

1 19. The method for truncating bit-planes in an enhancement layer of a group of pictures

2 for allocating bits sent to a client channel as claimed in claim 18, wherein said low-

3 rate bit truncation allocates each I/P-frames of said enhancement layer with a number

4 of bits proportional to a ratio of the number of bits used for prediction in each I/P-

5 frames to total number of bits used for fine prediction for all I/P-frames in said group

6 of pictures, and allocates no bit to any B-frame of said enhancement layer.

1 20. The method for truncating bit-planes in an enhancement layer of a group of pictures

2 for allocating bits sent to a client channel as claimed in claim 19, wherein said

3 medium-rate bit truncation allocates each I/P-frames of said enhancement layer with a

4 number of bits equal to the number of bits used for fine prediction in each I/P-frames,

5   and allocates each B-frame of said enhancement layer with a number of bits

6   proportional to a ratio of the number of enhancement-layer most significant bits used

7   for fine prediction in each B-frame to total number of enhancement-layer most

8   significant bits used for fine prediction for all B-frames in said group of pictures.

1 21. The method for truncating bit-planes in an enhancement layer of a group of pictures

2   for allocating bits sent to a client channel as claimed in claim 20, wherein said high-

3   rate bit truncation allocates each I/P-frames of said enhancement layer with a number

4   of bits equal to the number of bits used for fine prediction in each I/P frames plus a

5   number of bits proportional to a ratio of the number of bits used for fine prediction in

6   each I/P-frames to the summation of total number of bits used for fine prediction for

7   all I/P-frames in said group of pictures and total number of enhancement-layer most

8   significant bits used for fine prediction for all B-frames in said group of pictures, and

9   allocates each B-frame of said enhancement layer with a number of bits proportional

10   to a ratio of the number of enhancement-layer most significant bits used for fine

11   prediction in each B-frame to the summation of total number of bits used for fine

12   prediction for all I/P-frames in said group of pictures and total number of

13   enhancement-layer most significant bits used for fine prediction for all B-frames in

14   said group of pictures.

1 22. The method for truncating bit-planes in an enhancement layer of a group of pictures

2   for allocating bits sent to a client channel as claimed in claim 21, wherein said

3   medium-rate bit truncation allocates each I/P-frames of said enhancement layer with a

4   number of bits equal to the number of bits used for fine prediction in each I/P-frames,

5   and allocates each B-frame of said enhancement layer with a number of bits

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6   proportional to a ratio of the number of enhancement-layer most significant bits used

7   for fine prediction in each B-frame to total number of enhancement-layer most

8   significant bits used for fine prediction for all B-frames in said group of pictures.

1   23. The method for truncating bit-planes in an enhancement layer of a group of pictures

2   for allocating bits sent to a client channel as claimed in claim 18, wherein said high-

3   rate bit truncation allocates each I/P-frames of said enhancement layer with a number

4   of bits equal to the number of bits used for fine prediction in each I/P frames plus a

5   number of bits proportional to a ratio of the number of bits used for fine prediction in

6   each I/P-frames to the summation of total number of bits used for fine prediction for

7   all I/P-frames in said group of pictures and total number of enhancement-layer most

8   significant bits used for fine prediction for all B-frames in said group of pictures, and

9   allocates each B-frame of said enhancement layer with a number of bits proportional

10   to a ratio of the number of enhancement-layer most significant bits used for fine

11   prediction in each B-frame to the summation of total number of bits used for fine

12   prediction for all I/P-frames in said group of pictures and total number of

13   enhancement-layer most significant bits used for fine prediction for all B-frames in

14   said group of pictures.